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**Li et al.**

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(54) **NANOENGINEERED THERMAL  
MATERIALS BASED ON CARBON  
NANOTUBE ARRAY COMPOSITES**

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(75) Inventors: **Jun Li**, Sunnyvale, CA (US); **Meyya  
Meyyappan**, San Jose, CA (US)

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(73) Assignees: **United States of America as  
Represented by the Administrator of  
the National Aeronautics and Space  
Administration**, Washington, DC (US);  
**NanoConduction, Incorporated**, Los  
Gatos, CA (US)

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*Primary Examiner*—Teresa J. Walberg

(74) *Attorney, Agent, or Firm*—John F. Schipper; Robert M.  
Padilla

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(52) **U.S. Cl.** ..... **165/185; 165/80.3**

(58) **Field of Classification Search** ..... 165/185,  
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See application file for complete search history.

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(57) **ABSTRACT**

A method for providing for thermal conduction using an array of carbon nanotubes (CNTs). An array of vertically oriented CNTs is grown on a substrate having high thermal conductivity, and interstitial regions between adjacent CNTs in the array are partly or wholly filled with a filler material having a high thermal conductivity so that at least one end of each CNT is exposed. The exposed end of each CNT is pressed against a surface of an object from which heat is to be removed. The CNT-filler composite adjacent to the substrate provides improved mechanical strength to anchor CNTs in place and also serves as a heat spreader to improve diffusion of heat flux from the smaller volume (CNTs) to a larger heat sink.

**30 Claims, 7 Drawing Sheets**

